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Engineering Design File

PROJECT NO. 23203

Waste Retrieval Process Technology Search for the OU 7-10 Stage III Project

Prepared for:
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This engineering design file documents the evaluation of equipment, materials, and systems reviewed for the waste retrieval process for the Operable Unit 7-10 Stage III Project. Specifically, retrieval confinement configurations, primary confinement materials, excavation and transport equipment, material-handling equipment, and contamination-control systems were researched, evaluated, and rated to determine which materials, equipment, and systems are most applicable to the retrieval process. This evaluation provided a means of scoping the available technologies and eliminating possibilities that are not considered viable alternatives.

Various technologies, available to five key design topics, were assigned rating values and down selected to the alternative and subsystems presented in this engineering design file. Further analysis and evaluation will be performed to down select the final recommended retrieval process to three to six possible overall retrieval processes. This final down selection will use the same rating values.

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	R/A	Typed Name/Organization	Signature	Date
Performer/ Author	N/A	Dianne E. Nishioka	Dianne E Nishioka	8/4/03
Author	A	Scott A. Jensen	Scott A Jensen	8/7/03
Approver/ Requester	A	Stephanie L. Austad	Stephanie Austad	8/4/03
Checker		Daryl A. Lopez	Daryl A Lopez	9/2/03
Doc. Control	AC	Annie Buttars	Annie Buttars	9/3/03

7. Distribution: (Name and Mail Stop) Stephanie L. Austad (3920), Steven A. Davies (3920), Arthur W. Doehl (3920), Robert N. Hanson (3920), Brent R. Helm (3920), Scott A. Jensen (3920), Guy G. Loomis (3710), Bryan C. Spaulding (2220), Stephanie S. Walsh (3920), David E. Wilkins (3920), Stage III Project File (Melissa Voyles) (3920)

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Waste Retrieval Process Technology Search for the OU 7-10 Stage III Project

1. INTRODUCTION

This engineering design file documents the evaluation of equipment, materials, and systems reviewed for the Operable Unit (OU) 7-10 Stage III Project waste retrieval process. Waste retrieval is to be performed within the Subsurface Disposal Area (SDA) of the Radioactive Waste Management Complex (RWMC) at the Idaho National Engineering and Environmental Laboratory (INEEL). Equipment, materials, structures, and systems were researched, evaluated, and rated to determine which are most applicable to the retrieval of waste from the SDA. The key design topics identified for this technology search are:

- Confinement configurations
- Primary confinement materials
- Excavation and transport equipment
- Material-handling systems
- Contamination-control systems

2. PURPOSE

Many technologies are available to support the OU 7-10 Stage III Project waste retrieval process at OU 7-10, which comprises Pit 9. This engineering design file documents the technologies that were researched. An initial evaluation of possible technologies was conducted and the most effective are presented.

3. SCOPE

For each topic, available technologies were identified, evaluated, and rated from 0 to ***3*** based on how practicable the technology was considered for the OU 7-10 Stage III Project retrieval process. The technologies were provided and rated by engineers experienced in respective areas. The technologies and associated ratings are for use in the next phase of the project, which is down selection to three to six potential overall retrieval processes. Those retrieval processes then will undergo further analysis and evaluation to select the recommended retrieval process for remediation of OU 7-10.

Evaluations of the technologies available for the topics listed above and the results of those evaluations can be found in the appendixes listed below:

- Appendix A—Waste Retrieval Process Technology Search for the OU 7-10 Stage III Project Topic: Retrieval Confinement Configurations
- Appendix B—Waste Retrieval Process Technology Search for the OU 7-10 Stage III Project Topic: Primary Confinement Materials

- Appendix C—Waste Retrieval Process Technology Search for the OU 7-10 Stage III Project Topic: Excavation and Transport Equipment

- Appendix D—Waste Retrieval Process Technology Search for the OU 7-10 Stage III Project Topic: Material-Handling Equipment

- Appendix E—Waste Retrieval Process Technology Search for the OU 7-10 Stage III Project Topic: Contamination-Control Systems.

Each technology discussion contains, at a minimum, the following information:

- Scope

- Approach

- Assumptions

- Retrieval process alternative descriptions.

4. BACKGROUND

The INEEL is a government facility managed by the U.S. Department of Energy. The INEEL is located 52 km (32 mi) west of Idaho Falls, Idaho, and occupies 2,305 km^2 (890 mi^2) of the northeastern portion of the Eastern Snake River Plain. The RWMC is located in the southwestern portion of the INEEL. The RWMC has been designated as Waste Area Group (WAG) 7, one of 10 WAGs at the INEEL under investigation pursuant to the *Federal Facility Agreement and Consent Order* (FFA/CO) (DOE-ID 1991) between the Idaho Department of Environmental Quality, the U.S. Environmental Protection Agency, and the U.S. Department of Energy Idaho Operations Office. Operable Unit 7-10, which comprises Pit 9, is located within WAG 7 in the northeast comer of the SDA. The cleanup of OU 7-10 is identified as the OU 7-10 Phase III Project.

Waste resulting from on- and off-Site generators was placed in OU 7-10 from November 1967 to June 1969. The SDA presently has an overburden that averages about 1.8 m (6 ft) thick. Approximately 7,100 m^3 (250,000 ft’) of overburden soil and approximately 4,200 m^3 (150,000 ft’) of packaged waste have been disposed of in OU 7-10. Approximately 9,900 m^3 (350,000 ft’) of soil was estimated to be distributed between and below the packaged waste when OU 7-10 was closed. The pit depth from ground surface to the bedrock is approximately 5.3 m (17.5 ft), and the horizontal dimensions are approximately 38 m wide by 122 m long (125 x 400 ft).

The OU 7-10 Record of Decision (DOE-ID 1993) was approved October 1993 and addresses the contamination of OU 7-10. The down selection for the selected remedy for OU 7-10 retrieved waste is evaluated and documented in “Technology Evaluation of Retrieval Options for the OU 7-10 Stage III Project.””

a. INEEL, 2003, “Technology Evaluation of Retrieval Options for the OU 7-10 Stage III Project,” INEEL/EXT-03-00526, Rev. OB, INEEL, July 2003.

4.1 Excavation Description

Operable Unit 7-10 is approximately 38 m wide by 122 m long (125 x 400 ft) with sheet piling on both sides driven to bedrock. Average overburden thickness determined from measurements taken from 43 probe holes drilled throughout the OU 7-10 area is 1.8 m (6 ft), with a 1.8-m (6-ft) waste zone depth and 0.6 m (2 ft) of underburden. The thickness of materials in 80% of OU 7-10 area is unknown, but is expected to be similar.

5. REFERENCES

DOE-ID, 1991, *Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory*, Administrative Record No. 1088-06-29-120, U.S. Department of Energy Idaho Operations Office; U.S. Environmental Protection Agency, Region 10; Idaho Department of Health and Welfare.

DOE-ID, 1993, *Record of Decision: Declaration of Pit 9 at the Radioactive Waste Management Complex Subsurface Disposal Area at the Idaho National Engineering Laboratory*, Administrative Record No. 5569, U.S. Department of Energy Idaho Operations Office; U.S. Environmental Protection Agency, Region 10; and Idaho Department of Health and Welfare.

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Appendix A

Waste Retrieval Process Technology Search for the OU 7-10 Stage lll Project

Topic: Retrieval Confinement Configurations

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Appendix A

Waste Retrieval Process Technology Search for the OU 7-10 Stage III Project

Topic: Retrieval Confinement Configurations

SCOPE

This appendix documents the evaluation of alternative confinement configurations for the Operable Unit (OU) 7-10 Stage III Project waste retrieval operations. This information is discussed in the following sections and summarized in Table A-1 at the end of this appendix.

APPROACH

The evaluation approach for each retrieval confinement configuration alternative includes the following:

- Describing alternative configurations for the confinement system including the applicability of each configuration for use in the retrieval operations at OU 7-10, which comprises Pit 9

- Listing advantages and disadvantages of each configuration

- Rating each configuration with a 0, 1, 2, or 3, with 3 being the most applicable.

ASSUMPTIONS

During this evaluation process, the following assumptions were made:

1. Retrieval of waste zone materials requires both a primary and secondary confinement whenever there is an exposed waste surface

2. A secondary weather enclosure will suffice as a secondary confinement

3. Alternatives 1 through 4 assume that the existing sheet piles at OU 7-10 will be used as part of the primary confinement system.

ALTERNATIVE DESCRIPTIONS

This section contains descriptions of the eight alternative confinement configurations considered in this evaluation.

Alternative 1: Large Structure, Clear Span Over Entire Pit

Alternative 1-a: Large Independent Buildings Covering All of Operable Unit 7-10

Description

Alternative 1-a (see Sketch No. 1, Figure A-1) provides a primary confinement structure over the entire area of OU 7-10. A secondary confinement, or protective structure, will enclose the primary confinement structure over OU 7-10. The structural framing of each building is independent of one another. Minimum inner plan dimensions of the primary structure are approximately 420 x 130 ft. Minimum outer plan dimensions of the secondary structure are approximately 440 x 150 ft. Overall height depends on retrieval-process equipment and the profile of the final roof-structure design.

Advantages

- Could be modified to provide a tertiary confinement system, if necessary. Construction of an intermediate liner system using either structural frame will provide a secondary confinement and allow the initial secondary to become the tertiary confinement. A tertiary confinement system has advantages during closure and D&D&D activities.

- Provides structures that do not require movement

- Provides easier achievement of seal around perimeter of building base than a movable alternative.

- Allows use of more standard construction materials and methods.

- Accommodates a greater number of retrieval alternatives.

- Can accommodate a larger selection of retrieval equipment alternatives.

Disadvantages

- Contamination of the large primary confinement will require a larger D&D&D activity and more secondary waste

- Most likely will require largest structures of the alternatives considered

- A retrieval alternative using building-mounted retrieval equipment will require structural analysis of a structural frame to support the retrieval equipment and designed to span the entire width of the pit

- Overall, the structure most likely would be higher than a single structural frame assembly

Cost of construction and D&D&D (materials and labor) may be greater, initially, than for other alternatives. However, the continuous operating schedule afforded by this alternative could be

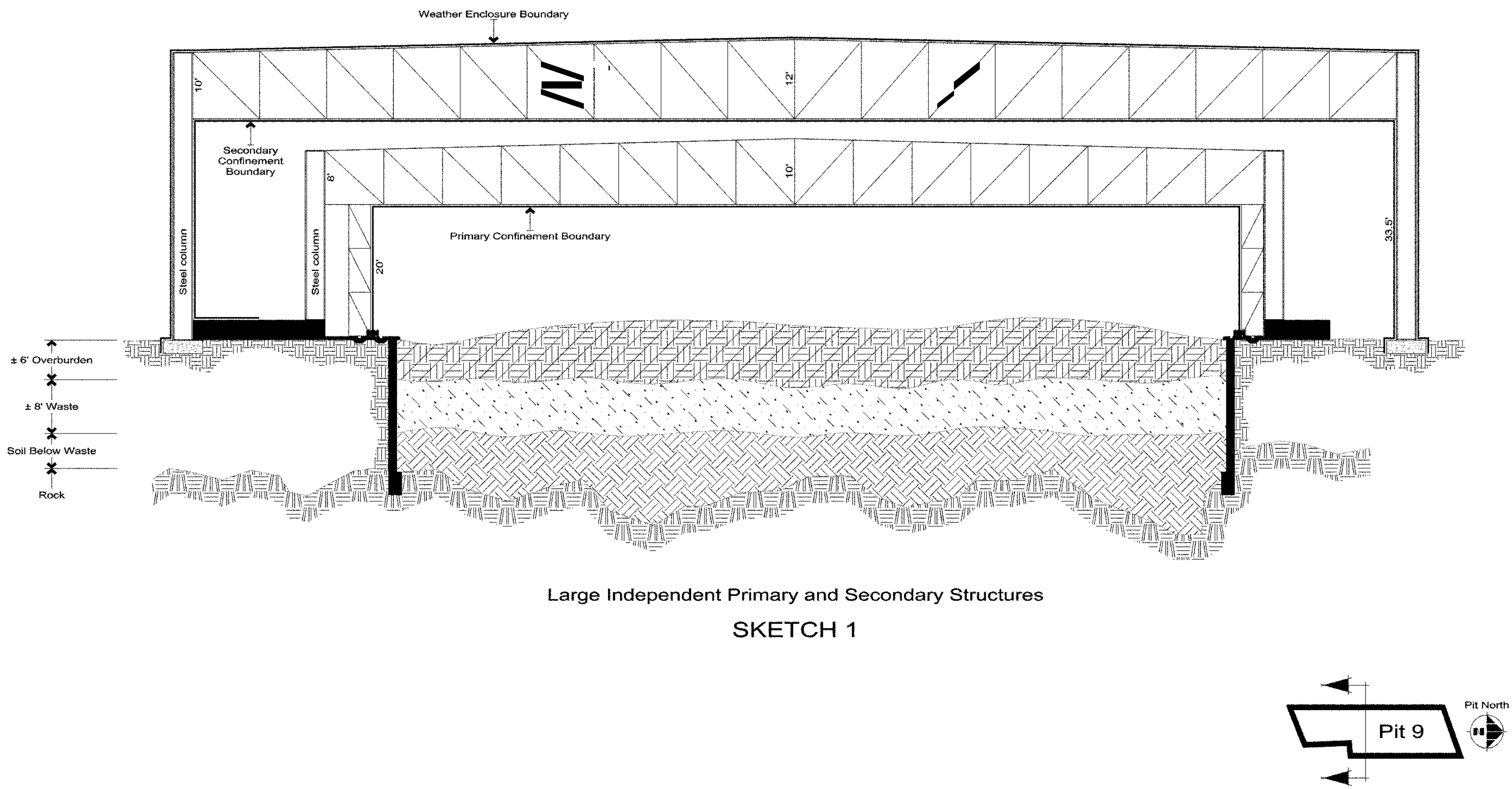


Figure A-1. Sketch No. 1 showing Alternative 1-a: Large independent buildings covering all of Operable Unit 7-10.

more cost effective. This alternative eliminates intermittent construction and operability testing required by sequential construction of smaller compartmentalized enclosures.

Alternative 1-b: Large Dual-Purpose Structure Covering All of Operable Unit 7-10

Description

Alternative 1-b (see Sketch No. 2, Figure A-2) provides a single structural framing system to cover the entire area of OU 7-10. The single framing system will support both the primary confinement and the secondary confinement or protective enclosure. The primary confinement boundary would consist of the inner surface or liner of the structural framing. The secondary enclosure most likely would be located on the outer surface or liner of the structural framing or could be located in an intermediate location within the framework. Minimum inner plan dimensions are approximately 420 x 130 ft. Outer minimum plan dimensions are approximately 440 x 150 ft. Height depends on the selected retrieval process equipment in conjunction with the selected building method.

Operational equipment and functions could be located in an operational corridor designed into the area between the secondary and primary boundaries. Preferably, these functions would be located outside the secondary boundary in separate or independent enclosures.

Advantages

- Provides a single structural framing system that supports both the secondary enclosure boundary and the primary confinement boundary
- Less secondary waste produced during D&D&D than two independent structures
- Provides a single structure that does not require movement
- Provides easier seal at the building perimeter base than movable alternatives
- Allows use of more standard construction materials and methods
- Can accommodate a larger number of retrieval system alternatives.

Disadvantages

- Entire interior surface of the primary confinement will become contaminated, which will entail larger D&D&D activities and more secondary waste compared to a smaller interior primary confinement structure.
- Requires a more substantial structural frame. Initial construction costs (mainly labor) could be more, but this alternative eliminates the necessity for two independent structural frames by providing one single frame to support both an inner primary liner (surface) and outer secondary liner (protective enclosure).
- A retrieval alternative using building-mounted retrieval equipment will require structural analysis and frame to span the entire pit width.

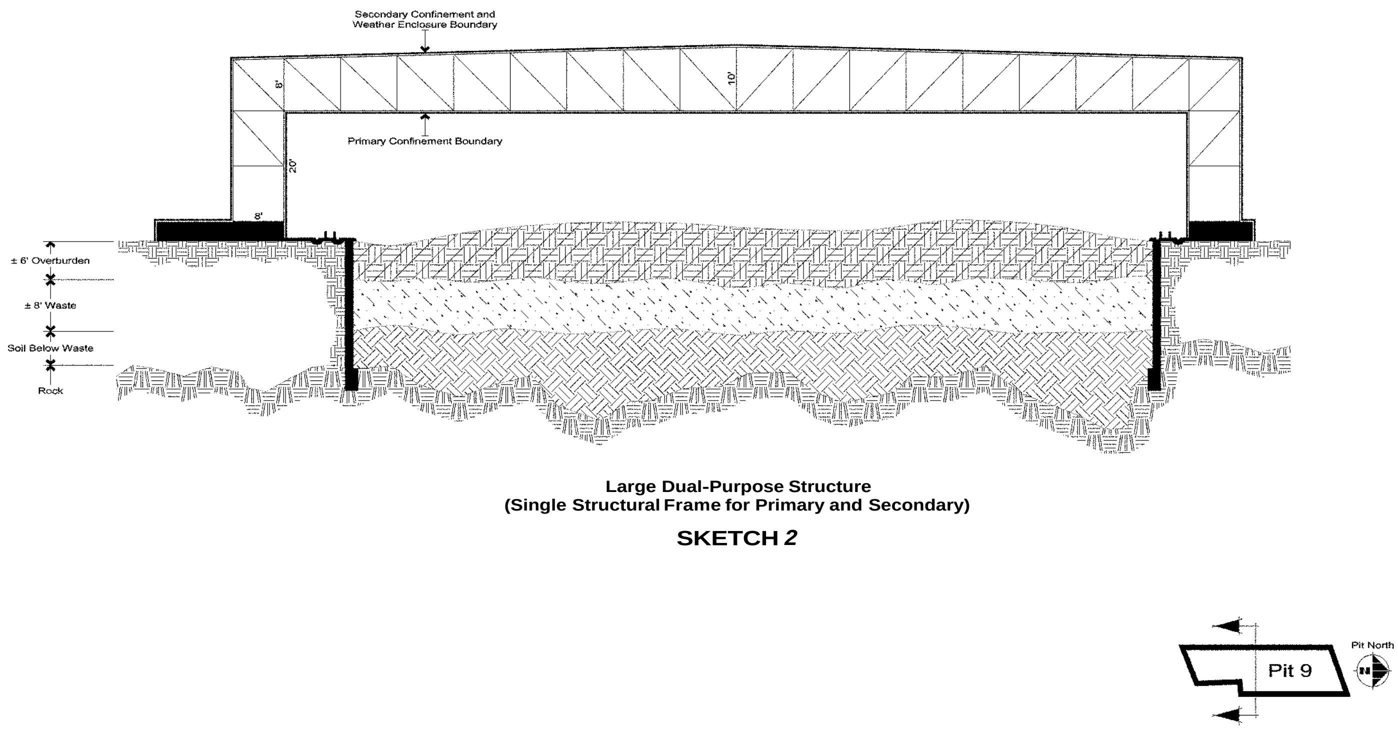


Figure A-2. Sketch No. 2 showing Alternative 1-b: Large dual-purpose structure covering all of Operable Unit 7-10

Alternative 1-c: Cover Operable Unit 7-10 with a Roof Near Existing Grade or at the Elevation of the Existing Concrete Foundations.

Description

Alternative 1-c (see Sketch No. 3, Figure A-3) is similar to the first alternative except that no walls are required.

Advantages

- Reduces the size of the confinement structure by reducing the overall confinement structure(s) height

- Less secondary waste during D&D&D than larger structures.

Disadvantages

- Limits the types of retrieval equipment

- Requires below-grade retrieval

- Requires consideration for transport and vehicle and equipment circulation to access underground activities, which may include an elevator system, ramp, or alternate conveyance system to the below-grade operational area

- May be limited by space required to construct these access systems

- More costly overall to construct, maintain, and equip.

Alternative 2: Large Structure, Contamination Control Walls

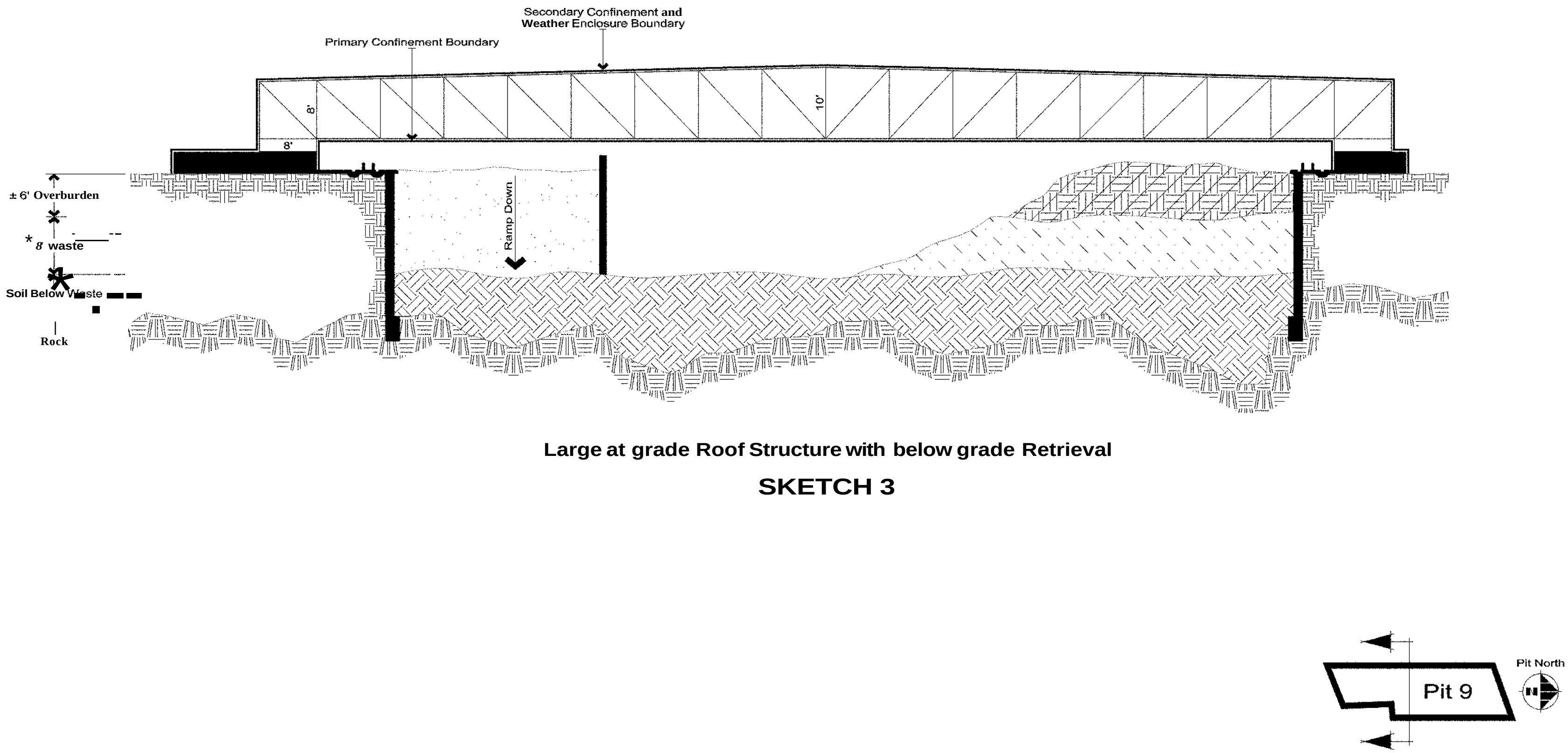
Alternative 2 (see Sketch 4) is similar to Alternatives 1-a, 1-b, and 1-c in providing an overall secondary confinement spanning the entire pit. However, movable or fixed interior walls would create smaller primary confinements to assist in reducing airborne contamination from spreading to other areas or the entire pit area.

Alternative 2-a: Large Building with Movable Contamination Control Walls

Description

Alternative2-a (see Sketch No. 4, Figure A-4) is similar and could use either Alternative 1-a or 1-b, large building systems for secondary and primary confinement structure(s). This alternative would use movable interior contamination control walls extending the full height of the work area and segregating designated areas of actual retrieval. This would allow subsequent activities (e.g., decontamination and closure or preparation of the next retrieval area) to proceed concurrently with activities in other areas of the pit boundary.

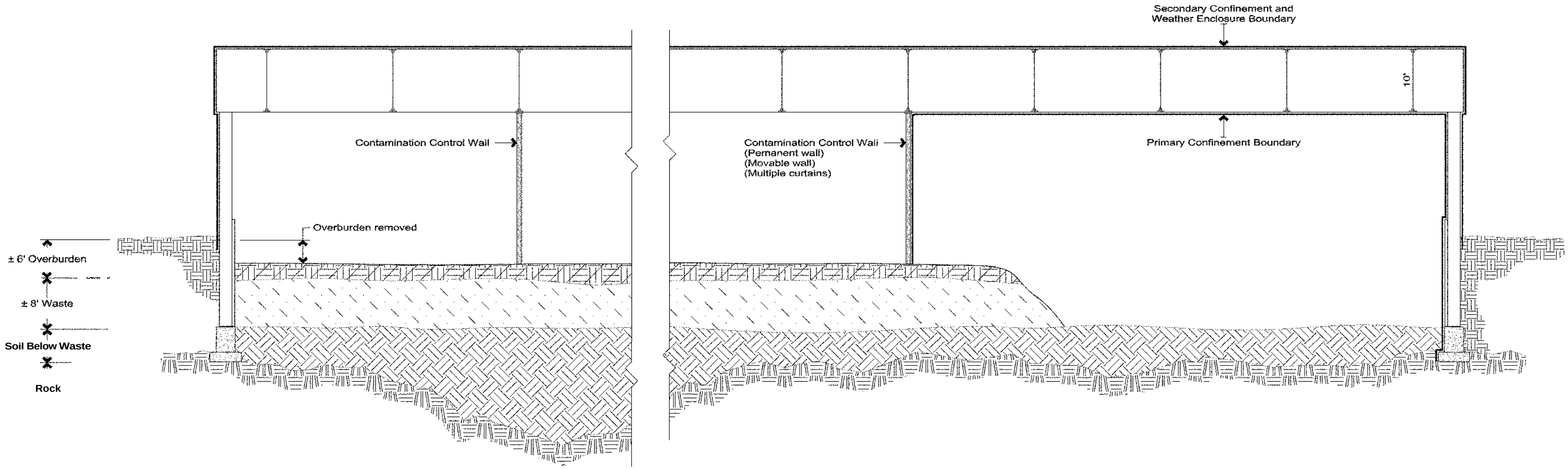
The intermediate moveable walls could be achieved through drop-down curtains, telescoping panels, or a rigid panel system installed to move along side mounted rails or overhead rail system(s).



Large at grade Roof Structure with below grade Retrieval

SKETCH 3

Figure A-3. Sketch No. 3 showing Alternative 1-c: Cover Operable Unit 7-10 with a roof near existing grade or at the elevation of the existing concrete foundations.



Large Structure with Segmented Control Areas

SKETCH 4

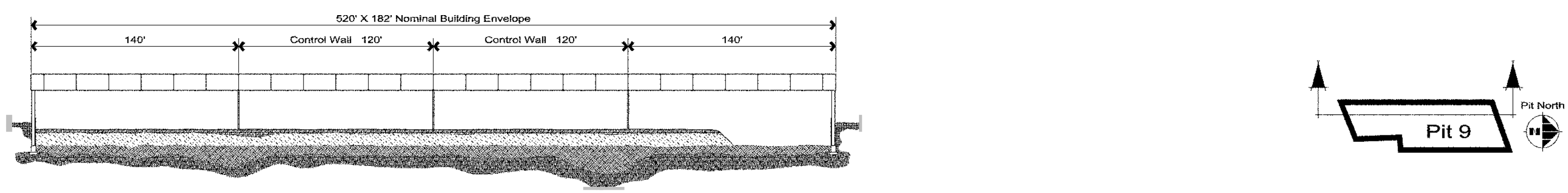


Figure A-4. Sketch No. 4 showing Alternatives 2-a, 2-b, and 2-c

Advantages

- Advantages similar to Alternative 1-a
- Reduces the area that has high contamination levels
- Allows underburden sampling in a lower-contamination-level area
- Allows pit closure activities in a lower-contamination-level area
- Accommodates compartmentalization of otherwise sequenced operational activities (i.e., retrieval vs. cleanup and closure vs. preparation for retrieval)
- Allows concurrent activities to take place with good potential for shortening the overall remediation schedule
- This alternative would require additional considerations relative to the logistics of accessing each area independent of the other.

Disadvantages

- Moving walls add complexity and additional equipment
- Entire inner confinement will become contaminated, though to a lesser degree than with no walls
- Requires large structures
- Does not allow large objects to be left in place unless contamination control walls are very flexible or disassembled and reassembled
- Difficulty in sealing at edges of the movable walls
- Limits choices for retrieval equipment
- Movable walls probably do not qualify as a confinement boundary, only as contamination control features.

Alternatives 2-b and 2-c (below) are similar to Alternative 2-a because both could use the same secondary or enclosure structure. The interior segmentation of waste retrieval could be achieved through various systems.

Alternative 2-b: Large Building with Permanent Contamination Control Walls

Description

Alternative 2-b (see Sketch No. 4, Figure A-4) is similar in concept to Alternative 2-a and could use either Alternative 1-a or 1-b large building systems for the secondary and primary confinement structure(s). Permanent contamination control walls would divide the building into smaller areas or compartments. Permanent walls could be constructed with standard building technology and extend from roof structure to grade. Sheet piles could be extended from grade through the waste area to the bottom of the pit, or telescoping walls could be used from roof structure to the bottom of the pit as retrieval progresses. Or the telescoping walls could extend from grade through the waste retrieval to the bottom of the pit.

Consideration needs to be given to the method and logistics of moving equipment from one cell or segment to the next as retrieval progresses. As in Alternative 2-a, this would allow subsequent activities such as decontamination and closure or preparation to proceed in the other areas of the pit boundary to occur concurrently.

Advantages

- Similar to Alternative 2a
- Reduces the area that has high contamination levels
- Contamination control walls are easier to seal at the roof and wall surfaces than movable walls
- Allows large objects to be left in place
- Allows underburden sampling in a lower-contamination-level area
- Allows pit-closure activities in a lower-contamination-level area.

Disadvantages

- Entire inner confinement will become contaminated although to a lesser degree than with no walls
- Requires large structures
- Difficult to seal at the pit surface
- Requires portable retrieval equipment
- Limits choices for retrieval equipment
- Constricts operation of retrieval equipment
- Equipment movement and material handling between the areas increases complexity
- Requires special construction to extend the wall down as the retrieval proceeds under the dividing wall or sheet piles to be placed in the pit first.

Alternative 2-c: Large Building with Multiple Contamination Control Curtains

Description

Alternative 2-c (see Sketch No. 4, Figure A-4) is similar to the Alternative 2 and *3* building systems for the secondary and primary confinement structure(s). Segmentation of retrieval process would use contamination curtains to divide the building into a number of smaller areas with potential lower-contamination levels in each area. Contamination curtains most likely extend from roof structure to grade, again using either piling from grade to pit bottom as waste is retrieved.

Advantages

- Similar to Alternatives 2-a and 2-b
- Reduces the area that has high contamination levels
- Allows large objects to be left in place
- Allows underburden sampling in a lower-contamination-level area
- Allows pit-closure activities in a lower-contamination-level area.

Disadvantages

- Entire inner confinement will become contaminated although to a lesser degree than with no walls Requires large structures
- Difficult to seal at the pit surface
- Requires portable retrieval equipment
- Limits choices for retrieval equipment Constricts operation of retrieval equipment
- Requires special construction to extend the wall down as the retrieval proceeds under the dividing wall.

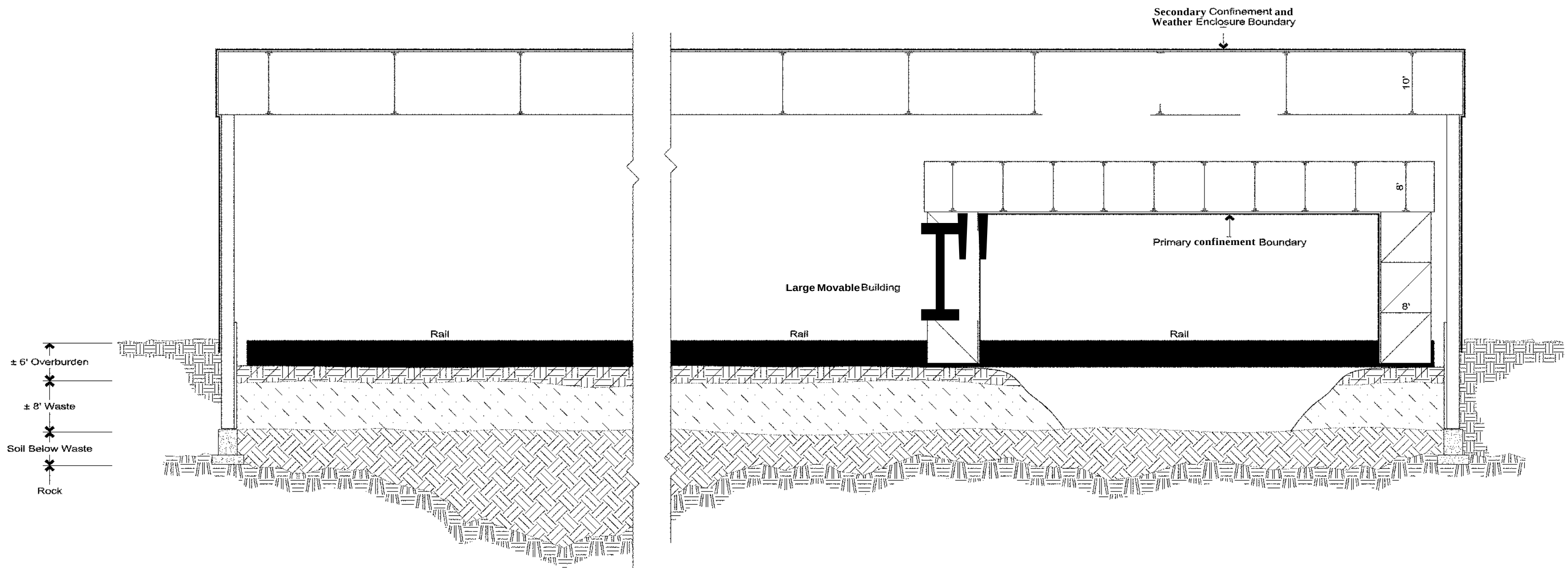
Alternative 3: Large Secondary Enclosure with Smaller Primary Confinement Structure

Description

Alternative ***3*** (see Sketch No. 5, Figure A-5) covers all of OU 7-10 with a building that serves as the secondary and protective enclosure. The inner primary enclosure is smaller and requires movement. Minimum inner plan dimensions are approximately 128ft x 40 ft. Actual primary confinement size would be driven by the method of retrieval selected and the equipment required. Minimum secondary enclosure inner plan dimensions are approximately 440 ft x 150ft. Height depends on retrieval equipment alternative.

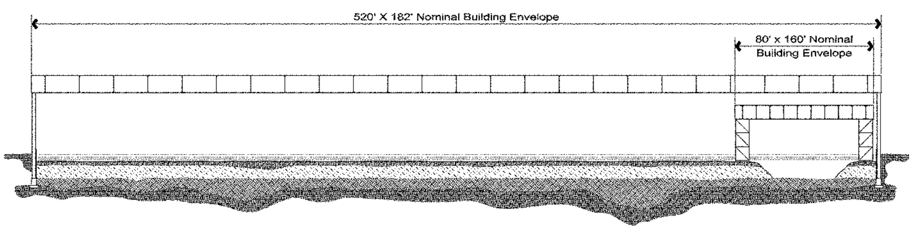
Advantages

- Reduces the size of the primary confinement structure
- Simplifies some contamination control issues
- The primary enclosure structure may be usable for retrieval operations on other SDA pits or trenches
- Fewer D&D&D operations are required and less secondary waste is produced by D&D&D.



Large Secondary Structure with **Smaller Primary Confinement**

SKETCH 5



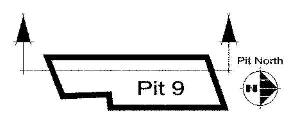


Figure A-5. Sketch No. 5 showing Alternatives ***3*** and 4.

Disadvantages

- Requires movement of the primary confinement building

- Requires some cleanup and closure of the excavated area before movement of the primary confinement structure

- Potential for contamination spread to the secondary enclosure during movement of the primary structure

- Sealing the structure after each move increases the difficulty of this alternative, from both design and operational perspectives.

Alternative 4: Small Movable Confinement Structures (Primary and Secondary)

Description

Alternative 4 (see Sketch No. 5, Figure A-5) is similar and covers a portion of OU 7-10 with a movable structure that serves as the primary confinement as well as the secondary enclosure. Minimum inner plan dimensions are approximately 128 ft x 40 ft. Height depends on the retrieval equipment alternative.

Advantages

- Reduces size of the confinement structure(s)

- Confinement structure may be usable for retrieval operations on other SDA pits or trenches

- Fewer D&D&D operations are required and less secondary waste is produced by D&D&D.

Disadvantages

- Requires movement of the confinement building

- Requires clean up and closure of the excavated area before moving the primary confinement structure

- Limits excavation equipment

- Difficulty in preventing contamination spread to the environment during movement of the structure and sealing the structure after each move increases the overall difficulty of this alternative

- Difficult to provide and maintain a seal at the pit surface

- Must be large enough to provide room for excavation, working around and with large objects, preparing the pit floor, and returning material to the pit

- Overall life-cycle costs may be impacted by the sequencing of decontamination, move of operations, retesting, and startup, if required.

Alternative 5: Very Small Moveable Confinement Structures (Primary and Secondary)

Description

Alternative 5 (see Sketch No. 6, Figure A-6) is similar to the previous alternative except that it requires some type of pit wall shoring system as the size of the structure is minimized. Minimum inner plan dimensions depend on the retrieval equipment alternative and shoring system used. Height depends on the retrieval equipment alternative.

Advantages

- Reduces the size of the confinement structure
- Confinement structure may be usable for retrieval operations on other SDA pits or trenches
- Fewer D&D&D operations are required and less secondary waste is produced by D&D&D.

Disadvantages

- Requires movement of the confinement building
- Requires installation of a pit wall shoring system
- Requires closure of the excavated area prior to movement
- Difficult to provide and maintain a seal at the pit surface
- Overall life-cycle costs may be impacted by the sequencing of decontamination, move of operations, retesting, and startup, if required.

Alternative 6: No Confinement—Weather Enclosure Only

Description

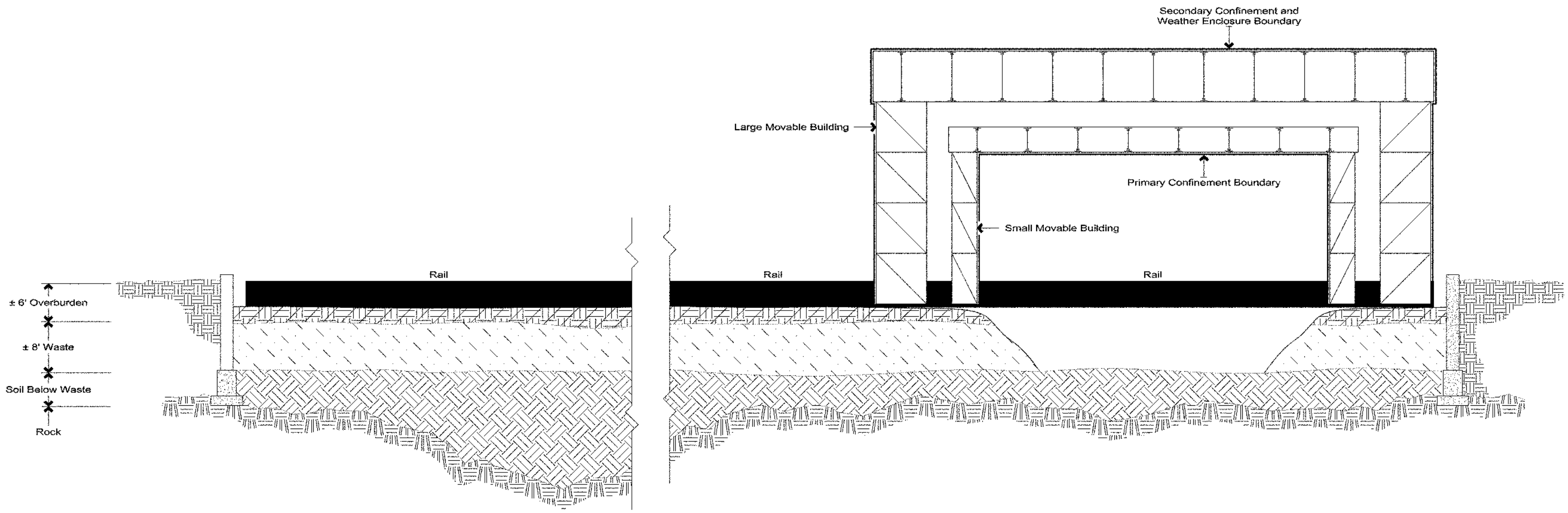
Alternative 6 (see Sketch No. 7, Figure **A-7)** would cover the pit with a weather enclosure only. The retrieval process would be to mine the waste from below the overburden and allow the overburden to collapse behind the excavation.

Advantages

- Reduces the substantial amount of material used for the larger confinement structure(s)
- The D&D&D activity may be easier compared to other building materials and methods.

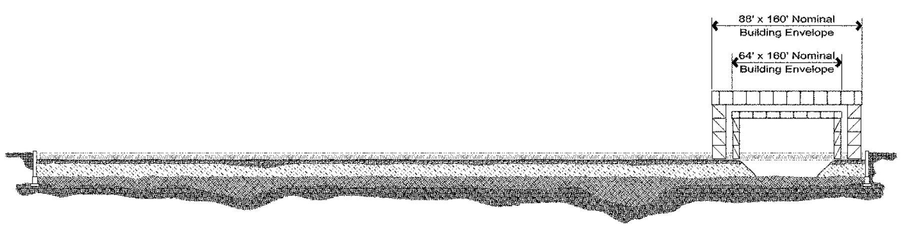
Disadvantages

- Presents fire- and explosion-control challenges commonly inherent in the building materials and methods associated with a weather enclosure



Small Movable Confinement Structures
(Primary and Secondary)

SKETCH 6



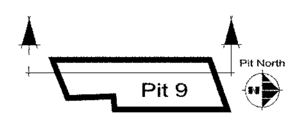
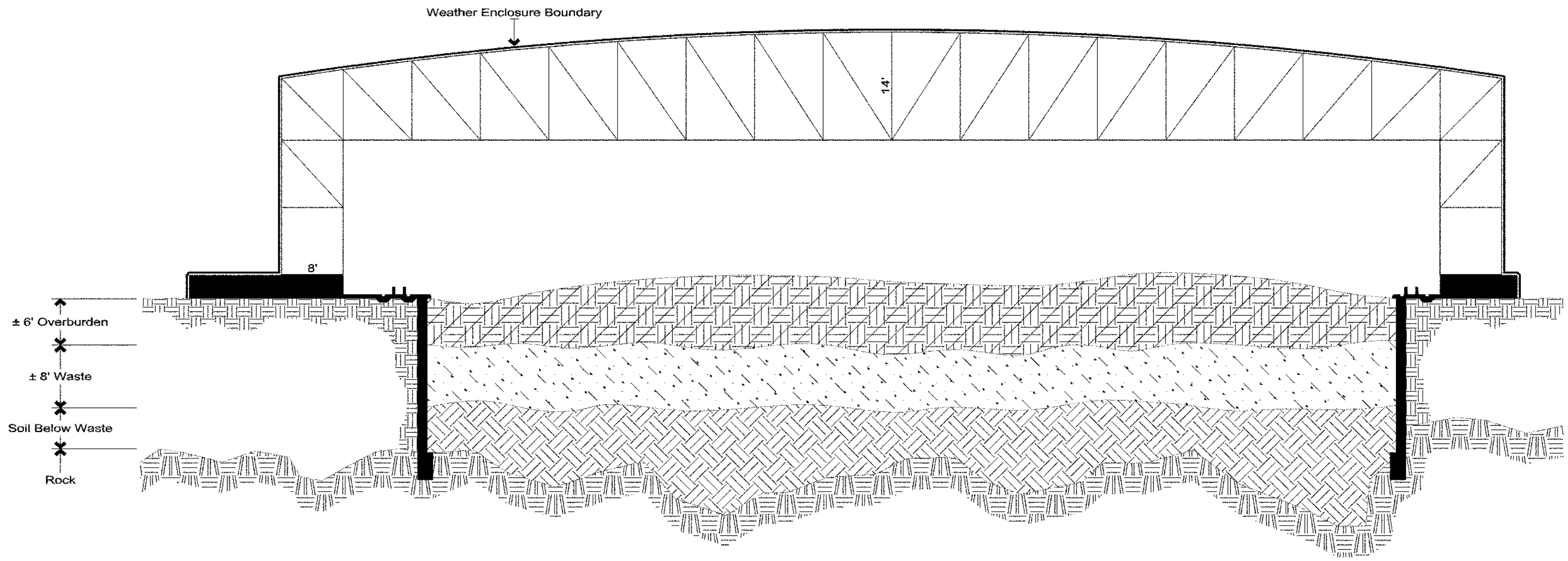


Figure A-6. Sketch No. 6 showing Alternative 5: Very small movable confinement structures (primary and secondary)



No Confinement - Weather Enclosure Only

SKETCH 7

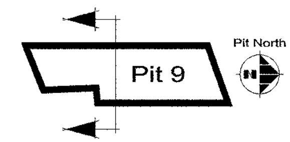


Figure A-7. Sketch No. 7 showing Alternative 6: No confinement- enclosure only.

- Requires alternative shielding and confinement for the retrieval process
- Limits excavation to underground mining techniques
- Produces extreme amounts of dust when the overburden collapses behind the excavation.

Alternative 7: Other Alternatives

Description

The following alternatives were brainstormed in an attempt to approach a paradigm change. Many of these alternatives were eliminated due to lack of proven technology, proof-of-principle, or precedence.

- Geotextile-membrane cover over area and mine from below. Requires tunnels below, in this case through basalt.
- Underground mining with shoring of roof. Controlled collapse with no return of material to the pit.
- Grout overburden in place and support cap with structural support from above (clear span truss over entire width of pit, hang cap off of structure). Would not work on Pit 10.
- Secondary confinement only. Need to apply a fixative as the primary containment.
- Magic box in the sense of a force field or magnetic bottle or box. No proven technology currently exists to substantiate a workable concept.
- Install a concrete (structural) slab over the pit before excavation. Requires below-grade mining and eliminates air infiltration. Limits equipment considered for the alternatives.
- Small movable fabric structure for contamination control (i.e., tent). Limits selection of retrieval equipment. Fabric presents fire-protection issues.
- Small foam dome that can be dissolved later with solvent.
- Large 14-in. auger:
  - Can be operated vertically or horizontally
  - Requires containment
  - Metals and large waste forms are difficult to handle.
- Caissons (tube): similar to auger.
- Double wall air supported internal structure: presents fire issues inherent with fabrics.
- Cryogenic freezing the ground: expensive and difficult to excavate.

- Spread plastic to cover the ground not being worked: difficult to maintain integrity and potentially complex.

- Dome over pit for confinement and enclosure: configuration of dome would not fit within the allowable pit boundaries.

Alternative 8: No Action

Description

Alternative 8 would leave waste and soil in place.

Advantages

- Incurs no costs for structures, equipment, or operations.

Disadvantages

- May not satisfy expectations for milestones set by the State of Idaho and U.S. Environmental Protection Agency (i.e., *Federal Facility Agreement and Consent Order* [DOE-ID 1991])

- Overall long-term life-cycle costs of administrative controls (long-term stewardship) may be more costly to monitor.

REFERENCE

DOE-ID, 1991, *Federal Facility Agreement and Consent Order for the Idaho National Engineering Laboratory*, Administrative Record No. 1088-06-29-120, U.S. Department of Energy Idaho Operations Office; U.S. Environmental Protection Agency, Region 10; Idaho Department of Health and Welfare.

Table A-1. Alternative confinement configurations for the Operable Unit 7-10 Stage III Project waste retrieval operations.

Alternative	Confinement Configuration	Comments	Rating[a]
1	Large structure spanning entire pit		—
	1-a. Large independent primary and secondary structures		3
	1-b. Large double-purpose structure (single structural frame for primary and secondary)		3
	1-c. Large at grade roof structure, with below-grade retrieval		3
2	Large structure(s) with contamination control walls		—
	2-a. Movable contamination control walls		3
	2-b. Permanent contamination control walls		3
	2-c. Multiple contamination control curtains		2
3	Large secondary structure with smaller movable primary confinement		2
4	Small movable confinement structure(s) (primary and secondary)	See descriptions in narrative text.	1
5	Very small movable structure(s) (primary and secondary)		0
6	No confinement, weather enclosure only		0
7	Other alternatives (see text narrative) • Geotextile membrane • Underground mining • Grout and support cap • Secondary confinement only • Magic box • Concrete structural slab • Small movable fabric structure • Small foam dome • Auger • Caissons • Air support • Freeze ground • Fluidized dig face (paraffin) • Plastic ground cover • Dome • Movable confinement		0
8	No action		0

a. Rating

3 = High probability of applicability
2 = Possible applicability
1 = Low probability of applicability to the OU 7-10 Stage III Project
0 = Not practical for the OU 7-10 Stage III Project

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Appendix B

Waste Retrieval Process Technology Search for the OU 7-10 Stage lll Project

Topic: Primary Confinement Materials

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Appendix B

Waste Retrieval Process Technology Search for the OU 7-10 Stage III Project

Topic: Primary Confinement Materials

SCOPE

This appendix documents the evaluation of materials that could be used as the primary confinement for the OU 7-10 Stage III Project retrieval process. The information discussed is contained in the following sections and a summary is included in Table B-1 at the end of this appendix.

APPROACH

Six alternative configurations for the primary confinement materials are described as well as their applicability. For each alternative the following information is provided:

- Applicability of each material for use in the retrieval operations at OU 7-10, which comprises Pit 9
- Advantages and disadvantages of using each material
- Rating of each material with a 0, 1, 2, or 3, with 3 being the most applicable (see Table B-1 at the end of this appendix).

ASSUMPTIONS

During this evaluation process, the following assumptions were made:

1. The retrieval primary confinement material will need to resist a design pressure of at least -1 in. (about 5 psf) of water and abnormal pressures as high as -4 in. of water (about 20 psf)
2. The primary confinement material must be decontaminable or the contamination must be able to be fixed before movement or demolition.

ALTERNATIVE DESCRIPTIONS

This section contains descriptions of the alternative confinement material types.

Alternative 1: Welded Stainless Steel Liner

Applicability

Use of 16-gage stainless steel sheet (0.063 in. thick) or thicker material. A structural frame to support the stainless steel is also required.

Advantages

- Provides excellent confinement
- Best material for decontamination
- Good for maintaining a seal during movement, if required
- Noncombustible
- Good system if the primary confinement structure is movable as an entire structure
- Good structurally, can be used as monocoque construction with support frame
- Excellent vacuum seal and structural vacuum resistance

Disadvantages

- Requires a great deal of welding and precise edge fit-up
- Relatively heavy
- Requires cutting to disassemble, which might be difficult if the surface could not be decontaminated to an acceptable level.

Alternative 2: Stainless Steel Liner with Gasket Joints

Applicability

Alternative 2 is similar to the Alternative 1 (stainless steel sheets) except that the joints have flat, overlap, elastomeric gasket seals. Seals would be similar to glovebox window seals.

Advantages

- Provides excellent confinement
- Best material for decontamination
- Maintains a seal during movement
- Easier to demolish than a welded structure
- Noncombustible with the possible exception of the gasket material.

Disadvantages

- Requires a lot of stud welding or bolting with nuts and washers
- Requires gasket material

- Requires separate, flat, metal strips for sandwiching the gaskets with the stainless sheets and for welding the studs to
- More difficult to maintain seal during movement
- Seal material may be affected by nitric acid decontamination solution
- 16-gage steel might require thicker backing strips to ensure gasket is compressed between bolts and studs.

Alternative 3: PermaCon System With Stainless Liner

Applicability

A system similar to an NFS-Radiation Protection Systems, PermaCon structure is used. The stainless liner material in Alternative ***3*** is riveted to a structural frame. Shop seams are caulked for sealing and caulking is required to provide a seal at field joints.

Advantages

- Provides good confinement
- Good material for decontamination
- Can be unbolted for demolition
- Noncombustible except for the possible exception of the caulk.

Disadvantages

- Requires a lot of caulking
- Hard to maintain seal during movement
- Caulk has a limited useful life.

Alternative 4: Painted Carbon Steel Liner

Applicability

Use of painted carbon steel instead of stainless steel. Seams and joints can be sealed by welding, gasketing, or a system of caulking. If strippable paint is used, decontamination for demolishing the facility is made easier.

Advantages

- Level of confinement depends on the method of seaming and sealing used
- Slightly easier to weld than stainless steel

- Material cost will be less than stainless steel if heavier-gage steel is required

Disadvantages

- Paint has a shorter design life than the stainless material
- Fire issues associated with strippable paint may prevent its use as a liner.

Alternative 5: Membrane Liner

Applicability

Use a fabric or membrane liner material with glued or thermally welded seams.

Advantages

- Level of confinement is good as long as the membrane is not punctured or torn
- Decontamination and demolition costs may be reduced.

Disadvantages

- Shorter design life
- Most membranes are fire resistive but are not noncombustible
- Fabrics or membranes are easier to tear or puncture than most metal liner materials.

Alternative 6: Combinations of Other Alternatives

Applicability

Use a combination of materials described in the above five Appendix B alternatives. For example, using a Permacon-type system for the primary confinement, but with a disposable membrane liner to contain contamination so the PermaCon remains uncontaminated.

Advantages

- Depends on the combination of materials used
- Decontamination and demolition costs may be reduced

Disadvantages

Depends on the combination of materials used.

Table B-1. Primary confinement material alternative numbers, confinement materials, and rating of each material.

Alternative	Confinement Material	Comments	Rating[a]
1	Welded stainless steel	See descriptions in narrative text.	3
2	Stainless steel with gasket joints		3
3	PermaCon system		2
4	Painted carbon steel		2
5	Membrane liner		1
6	Combination		3

a. Rating

3 = High probability of applicability
2 = Possible applicability
1 = Low probability of applicability to the OU 7-10 Stage III Project
0 = Not practical for the OU 7-10 Stage III Project

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Appendix C

Waste Retrieval Process Technology Search for the OU 7-10 Stage lll Project

Topic: Excavation and Transport Equipment

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Appendix C

Waste Retrieval Process Technology Search for the OU 7-10 Stage III Project

Topic: Excavation and Transport Equipment

SCOPE

This appendix documents the evaluation of excavation and transportation technologies that could be applied to the OU 7-10 Stage III Project retrieval and transport process. The information discussed is contained in the following sections and a summary is included in Table C-1 at the end of this appendix.

APPROACH

The evaluation approach for each alternative for excavation and transport equipment included the following:

- Listing all available surface and underground mining equipment, construction equipment, and other specialty equipment
- Stating the applicability of each equipment type for use in the retrieval process for OU 7-10 Stage III Project
- Commenting on capabilities for each unit (rather than listing advantages and disadvantages as in previous appendixes)
- Rating the applicable equipment with a 0, 1, 2, or **3,** with **3** being the most applicable (see Table C-1).

ASSUMPTIONS

Equipment will operate inside a controlled-environmentenclosure with minimal human intervention.

ALTERNATIVE DESCRIPTIONS

The alternatives (see Table C-1) are divided into four sections:

- Surface mining equipment
- Support equipment
- Underground equipment
- Remote-control equipment.

EXCAVATION CONFIGURATION

Operable Unit 7-10 is approximately 38 m wide by 122 m long (125 x 400 ft) with sheet piling on both sides driven to bedrock. Average overburden thickness in the 43 probe holes of OU 7-10 is 1.8 m (6 ft), with a 1.8-m (6-ft) waste zone and 0.6 m (2 ft) of underburden. Actual thickness measurements for 80% of OU 7-10 are not known, but are expected to be similar.

Excavation and handling of waste must be performed in a controlled environment with minimal human entry because of potential plutonium fines inhalation. Therefore, remote control equipment is necessary.

Table C-1. Excavation and transport equipment list.

Alternative	Type of Retrieval Equipment	Comments on Capabilities	Rating[a]
		Surface Mining Equipment	
1	Walking dragline	Too big, poor control.	0
2	Crawler dragline	Too tall, poor control.	0
3	Electric shovel	Poor selectivity.	1
4	Hydraulic shovel	Fair selectivity.	2
5	Hydraulic excavator (track backhoe)	Good selectivity, many attachments, good stability without outriggers.	3
6	Hydraulic excavator (wheel backhoe)	Good selectivity, mobility, outriggers for stability.	2
7	Telescoping excavator (track backhoe)	Good for low-height operation.	3
8	Telescoping excavator (track, shovel)	Good for excavation from below	3
9	Wheel-loader backhoe	Small, versatile, outriggers for backhoe operation.	2
10	Track-loader backhoe	Small, cannot efficiently tram very far.	1
11	Wheel loader (front-end loader)	Load from below and tram to process area; big bucket will not tear up drums, especially if assisted by excavator; road dust minimized at low speeds and with dust suppressant; ideal for returning waste to pit.	3
12	Track loader (tractor with loader bucket)	Loads from below, cannot efficiently tram very far.	1
13	Skid-steer loader (bobcat loader)	Too small, poor control, tears up the floor.	1
14	Wheel loader with square tray	Load tray with excavator and tram to process area; cannot load itself—requires backhoe or clamshell.	3
15	Wheel loader with forks and square trays	Several trays could be loaded by excavator and trammed to process area.	3
16	Forklift – rough terrain	Several trays could be loaded by excavator and trammed to process area.	3

Table C-1. (continued).

Alternative	Type of Retrieval Equipment	Comments on Capabilities	Rating[a]
17	Forklift – flat terrain	Poor stability on uneven or soft floor.	0
18	Telescoping forklift	Several trays could be loaded by excavator and trammed to process area.	3
19	Integrated tool carrier with attachments	Similar to front-end loader, but with other fork or grapple attachments.	3
20	Hydraulic excavator track with material-handling boom	Long-reach boom and various attachments (see below).	3
20a		Bucket attachments.	3
20b		Fork attachments.	3
20c		Material handling attachments.	3
20d		Grapple attachments.	3
20e		Pick attachments.	3
20f		Manipulator attachments.	3
21	Electric bucket-wheel excavator	Too big—not selective.	0
22	Hydraulic bucket-wheel excavator	Not selective, dust at transfers.	1
23	Chain excavator (track)	Not selective, dust at transfers.	1
24	Fixed-belt conveyor	Convey to process area, problems with big items; difficult to load; spillage.	2
25	Mobile-belt conveyor	Convey to fixed conveyor or to process area and back to pit, problems with big items.	1
26	Beltwagon (transfer conveyor)	Convey to fixed conveyor, problems with big items.	1
27	Mobile stacker (conveyor)	Convey to stockpile or back to pit.	2
28	Fixed stacker (conveyor)	Convey to stockpile.	2
29	Radial stacker (conveyor)	Convey to stockpile.	2
30	Transfer hopper (conveyor)	Needed for loading conveyors.	2
31	Easi-Miner (rotating cutter)	Too big; dust, shreds, and homogenizes material; can cut in layers.	0
32	Other rotating earth cutters	Dust, shreds and homogenizes material, can cut in layers.	1
33	Cold planer (pavement cutter)	Dust, shreds and homogenizes material; can cut in layers, cannot excavate into corners and ends.	1

Table C-1. (continued).

Alternative	Type of Retrieval Equipment	Comments on Capabilities	Rating[a]
34	Holland loader	Shears dirt bank but not metals and plastics; homogenizes materials, dust.	0
35	Truck crane with clamshell bucket	Requires very tall building, fair selectivity; dribbles dust; could work from pit floor and swing to conveyor or rail car.	1
36	Hydraulic truck crane with clamshell	Requires tall building; fair selectivity; dribbles dust; could work from pit floor and swing to conveyor or rail car.	2
37	Rough terrain crane with clamshell	Good mobility; fair selectivity dribbles dust; could work from pit floor and swing to conveyor or rail car.	2
38	Overhead crane with clamshell, bin, tray	Good mobility; fair selectivity; dribbles dust; could transport material from pit to process area.	2
39	Gantry crane with grapple, clamshell, and tray	Could be used to excavate and transport material from pit to process area.	2
40	Gantry crane with lights, cameras, sprays, sensors	Very versatile for support and dust control.	3
41	Tower crane with clamshell, bin, tray	Fair selectivity; dribbles dust; could deliver material from pit to conveyor or railcar.	1
42	Crawler tractor (bulldozer)	Poor selectivity; could doze material onto a tray	1
43	Wheel tractor (wheel bulldozer)	Poor selectivity; could doze material onto a tray	1
44	Landfill wheel tractor (steel wheels)	Poor selectivity; could doze material onto a tray, steel wheels made for compaction.	1
45	Wheel tractor scraper	Cannot recover material from corners; poor selectivity; cannot dump in bin or process pad.	0
46	Towed scraper (can)	Cannot recover material from corners, poor selectivity, and cannot dump in bin or process pad.	0
47	Farm tractor with scraper (can)	Cannot recover material from corners; poor selectivity; cannot dump in bin or process pad.	0
48	Farm tractor with trailer	Could be used to move a bin or tray to process area.	1
49	Rear dump truck	Could haul and dump at process area and return waste to pit.	2
50	Articulated rear dump truck	Made for poor road conditions; could haul and dump at process area and return waste to pit.	2
51	Side dump truck	Could haul and dump at process area and return waste to pit.	1

Table C-1. (continued).

Alternative	Type of Retrieval Equipment	Comments on Capabilities	Rating[a]
52	Bottom dump truck	Could haul and dump at process area and return waste to pit; requires dump hopper or laydown area.	1
53	Vacuum truck	For moving or cleaning dirt overburden and underburden (waste is too large and would plug the inlet or tube); high suction required, 18-yd^3-maximum-capacity tank, good filtration; problems with potential plugging caused by high moisture content of soil; potential for criticality concerns; moist, clayey silt soil present in Pit 9 is difficult to vacuum without drying and breakup tools.	1
54	Vacuum system on gantry crane or overhead crane	For moving or cleaning dirt overburden and underburden (waste is too large and would plug the inlet or tube); high suction required, good filtration; problems with hose and pipe handling; potential plugging caused by high moisture content of soil; potential for criticality concerns; moist, clayey silt soil present in Pit 9 is difficult to vacuum without drying and breakup tools.	
55	Integrated transfer module	This is a bucket with a cover that has a common coupler that can be handled by excavation, transport and handling equipment to reduce spillage and dust.	3
		Support Equipment	
1	Motor grader	For maintaining roads, removing thin layers.	1
2	Water truck	For dust control.	3
3	Service truck (fuel and lube)	For equipment fuel and lube.	1
4	Mechanic truck	For equipment maintenance and repair.	1
5	Fuel truck	For equipment fueling.	2
6	Welding truck	For installation and repairs.	1
7	Blast-hole drill	Potential for bulk samples.	1
8	Exploration drill	For taking small samples.	1
9	Drill buggy	For coring in tight conditions.	1
10	Hummvee	For transporting parts, supplies, dust spray, cameras, lights, detectors, and samplers.	3
11	Four-wheel-drive pickup truck	For transporting parts, supplies, dust spray, cameras, lights, detectors, and sampling equipment.	3
12	Rough-terrain articulating boom man-lift work platform	Used to access contaminated area for equipment repairs.	3
		Underground Equipment	
1	Continuous miner	Shreds material and conveys it out the back,	1

Table C-1. (continued).

Alternative	Type of Retrieval Equipment	Comments on Capabilities	Rating[a]
		homogenizes material, lots of water sprayed to reduce dust, which would make mud.	
2	Mobile chain conveyor	Shuttles material from continuous miner to main conveyor.	1
3	Mobile belt conveyor	Shuttles material from continuous miner to main conveyor.	1
4	Hanging belt conveyor	Moves material on belt; could be mounted at side or center of building.	1
5	Roadheader (rotating-pick rock cutter)	Shreds material and conveys it out the back; homogenizes material; lots of water sprayed to reduce dust, which would make mud.	1
6	Slusher (bucket on double-drum winch)	Loads material, drags it toward the winch, and dumps into subgrade dump pocket and conveyor; poor selectivity.	0
7	Drill jumbo (with multiple booms)	Four-wheel-drive vehicle with booms could be used for detectors, sampling, lights, cameras, water sprays.	2
8	Load-haul-dump (front-end loader)	Low-profile front-end loader with big bucket to load material and haul to process area.	3
9	Mucking machine (pneumatic)	Rail- or track-mounted machine with bucket to dig and dump into rail car; small; problems handling big items; dust.	1
10	Rail cars	Could haul material from pit to process area.	2
11	Locomotives (battery powered)	Used to pull rail cars.	2
12	Hoists	Used to lift material to another level.	0
13	Fans, air ducts, air doors	Used for airflow control.	3
14	Air heaters, coolers, humidity control	Used to condition air.	3
15	Highwall miner	Used for remote mining of underground coal seams from the surface; includes continuous miner, cascading conveyor cars, cameras, gamma sensors, guidance systems, water sprays.	0
16	Cascading conveyor cars	20- to 40-ft conveyor cars on wheels.	1
		Remote Control Equipment	
1	Equipment adapted with remote control technologies for the OU 7-10 Stage III	Remote-control technology is adaptable to any equipment, although remote control is not standard on any surface mining equipment. Some of the underground equipment use pendant (hard-wired) or	2

Table C-1. (continued).

Alternative	Type of Retrieval Equipment	Comments on Capabilities	Rating[a]
	Project	wireless remote control systems to allow the operator to stay out of the danger zone and operate from a clean direct-observation vantage point. Continuous miners, conveyor cars, and shuttle cars with remote control are common.	
2	Commercially available remote equipment	Load-haul-dump machines with remote controls have been in use for the last 20 years. After **3** days of training, a load-haul-dump machine operator can operate more efficiently remotely than in the cab. The radio controls are either worn on a shoulder sling with a joystick panel and mini-TV, or can be pedestal-mounted.	**3**
		Remote control on highwall mining systems allows control of the continuous miner cutter head, steering, gathering arms, and conveyor from 1,500 ft away in the control cab. This system allows a coal seam to be mined underground from a surface contour cut highwall with no personnel going underground.	
		Water is sprayed on the camera lens and light covers wash away dirt and prevent fogging. Top and bottom of coal are remotely sensed with gamma, and position is remotely sensed with a guidance system to keep the cut straight. Similar technology can be applied to excavation and transport equipment selected for OU 7-10.	

a. Rating

3 = High probability of applicability
2 = Possible applicability
1 = Low probability of applicability to the OU 7-10 Stage III Project
0 = Not practical for the OU 7-10 Stage III Project

OU = operable unit

NOTES ON REMOTE-CONTROL EQUIPMENT

Operation of Equipment

Operation of mobile equipment (e.g., backhoe, front-end loader, boom vehicle, or spray vehicle) is expected to be performed from a duplicate control cab located in a clean room with a direct view of the whole Pit-9 and material-dump and stockpile areas. Cameras on swivel mounts would be mounted at various positions on the vehicle. Television monitors surrounding the clean-room control cab could give the operator a better view of the digging area than the operator would have in the actual machine cab. Some mine haul trucks use cameras and monitors to view blind spots around and behind the truck.

Operation of fixed equipment (e.g., pedestal-mount boom with material handling attachments) also would be remotely controlled from a good vantage point with cameras and television monitors for a closer view. These could be pendant-controlled or wireless.

Development of Systems

Development of a remote control system for the selected technology will require additional time and money and require additional testing and training. Remote control should be considered proven technology even though it may not be off-the-shelf for standard equipment models.

Manufacturers

Equipment manufacturers typically rely on a specialty company to provide remote control systems. Several companies provide remote control technology that is rapidly improving. These companies have provided remote control for a great variety of equipment types, wherever a customer has a justified need for a remote operation.

Appendix D

Waste Retrieval Process Technology Search for the OU 7-10 Stage lll Project

Topic: Material Handling Equipment

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Appendix D

Waste Retrieval Process Technology Search for the OU 7-10 Stage III Project

Topic: Material Handling Equipment

SCOPE

This appendix documents the evaluation of material handling subsystems that could be used for the OU 7-10 Stage III Project retrieval operations. This equipment could be used either inside radiological confinement or outside. The information discussed is in the following sections and a summary is included in Table D-1 at the end of this appendix.

APPROACH

The evaluation approach for each material handling subsystem alternative included the following:

- Listing feasible material-handling systems including material transport and material preparation equipment
- Stating applicability of each subsystem for use in the retrieval operations of the OU 7-10 Stage III Project
- Commenting on capabilities for each unit (rather than listing advantages and disadvantages as in previous appendixes)
- Rating each system with a 0, 1, 2, or 3, with 3 being the most applicable (see Table D-1).

ASSUMPTIONS

During this evaluation process, the following assumptions were made:

1. The OU 7-10 area, including additional land critical to the retrieval process, will be covered with a weather enclosure structure.
2. Active areas, including OU 7-10 and adjacent operational areas, will be enclosed with an appropriate level of confinement and will be provided with the appropriate required ventilation.
3. All retrieved waste will be delivered to a staging or sorting area by the excavation and transport equipment evaluated in Appendix C.

ALTERNATIVE DESCRIPTIONS

Material-handling, including waste-transportation and waste-preparation equipment for delivering retrieved waste to temporary staging (possibly located in an existing structure or area or new structure or area outside of the Subsurface Disposal Area), physical analysis, radiological assay, process treatment, classified storage, and final disposition destinations are presented in Table D-1.

Table D 1. Material handling and waste-preparation equipment.

Alternative Number	Type of Equipment	Comments	Rating[a]
	Materials Transport Equipment		
1	**Belt conveyors**		
1a	Troughed belt, idler, and slider type. Properly designed, these are extremely flexible, durable, and reliable	Used primarily for loose bulk materials, but will accommodate oversized unit items	3
1b	Flat belt, idler and slider type Note: Belting materials can be from a variety of materials; rubber compounds, synthetic materials, stainless steel	Ideal for sorting materials and presenting materials at a controlled depth to inspection and testing operations	3
2	**Apron conveyors**		
	Ideal for both bulk and unit material streams; all steel construction; will withstand heavy impact loading; can be configured from narrow to wide widths. Very durable; medium maintenance and clean up	If metal carrying surface is not a problem, has same attributes as flat belt conveyors	2
3	**Pan/vibrating headers**		
	Have solid, flat, U-shaped pan for the conveying surfaces; can be of any type of metal construction required; handles both bulk and unit items. Durable and clean; requires solid foundations	Limits to length of single units; somewhat noisy during operation; no "return" runs to contend with for clean up	2
4	**Roller conveyors**		
	Limited to unit handling operations. Provides intermediate (based on roller spacing) support to conveyed loads. Loose materials must be placed in containers for conveying. Loose materials on outsides of containers will fall through and accumulate below conveyor	Can be configured with transfers and turntables to accommodate process stations; easy to automate functions	2
5	**Automatic guided vehicle**		
	Extremely flexible, reliable, and adaptable. Limited to handling unit loads of standardized sizes.	Easy to automate functions and paths of travel. Ideal if all loads are unitized in standard containers.	2

Table D-1. (continued)

Alternative Number	Type of Equipment	Comments	Rating[a]
6	**Forklift trucks**		
	Requires continuous operator interface. All loads must be containerized, and if necessary, on pallets.	Needs continuous operator interface. Other methods less expensive in operator time and better suited to remote operations, if needed.	1
7	**Slat convevors**		
	Flat surface for handling unit loads; slats can be wood or metal construction	High maintenance, not flexible	0
8	**Belt conveyors with molded vertical side skirts**		
	Similar in profile and functionality to apron conveyors, but with much more carry back of material on the return run	Better suited to bulk materials than unit handling; limits to available widths	1
9	**Overhead power and free conveyor**		
	Handles all conveyed materials in standard-sized containers; can function in automated modes for each individually conveyed load	Very flexible, reliable, and durable. But requires support structure.	1
10	**Tractor and cart svstem**		
	Very reliable, flexible, and requires part-time operator interface. Individual carts can be configured to carry unit or bulk loads.	Not easy to automate interfaces with process stations	0
	Material Preparation Equipment		
1	Magnetic separator	For removal of ferrous metals from bulk-retrieved waste	2
2	Metal detector	For removal of nonferrous metals from retrieved waste	2
3	Scale system	Weigh retrieved waste	3
4	Gantry crane with clamshell	To sort retrieved waste	2
5	Material-handling boom with various attachments	To sort retrieved waste	2
6	Shredder	To produce consistent waste sizing and to allow for efficient packaging	2

Table D-1. (continued)

Alternative Number	Type of Equipment	Comments	Rating[a]
7	Screen	To sort retrieved waste by size	1
8	Vibrating spreader feeder	Support equipment for packaging and feeding other equipment	3
9	Packaging hoppers with feeders	To handle retrieved waste and repack it into drums and boxes	3
10	FIBC filling systems	To package bulk retrieved waste into bulk bags	2
11	Gantry crane with analysis instrumentation	To detect hot spots during excavation or retrieval	2
12	Box unloading system	To empty retrieved boxes of waste for characterization, sorting, and repackaging	1
13	Drum extruder system	To empty or decant drums	1

a. Rating

3 = High probability of applicability
2 = Possible applicability
1 = Low probability of applicability to the OU 7-10 Stage III Project
0 = Not practical for the OU 7-10 Stage III Project

FIBC = flexible intermediate bulk container

Appendix E

Waste Retrieval Process Technology Search for the OU 7-10 Stage III Project

Topic: Contamination Control Systems

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Appendix E

Waste Retrieval Process Technology Search for the OU 7-10 Stage III Project

Topic: Contamination Control Systems

SCOPE

This appendix documents the evaluation of possible contamination-control systems for the OU 7-10 Stage III Project retrieval process. The information discussed is in the following sections and a summary is included in Table E-1 at the end of this appendix.

APPROACH

The evaluation approach for contamination-control system alternatives includes the following:

- Listing available contamination-control systems
- Stating applicability of each system for use in the retrieval operations of the OU 7-10 Stage III Project
- Commenting on capabilities for each unit (rather than listing advantages and disadvantages as in previous appendixes)
- Rating the system with a 0, 1, 2, or ***3***, with ***3*** being the most applicable (see Table E-1).

ASSUMPTIONS

During this evaluation process, the following assumptions were made:

1 The preferred path is to start with a clean operation and work as cleanly as practical to allow entry of bubble-suited personnel for routine maintenance of equipment and monitoring devices.

2 Placement of assayed material that is less than 100 nCi/g transuranic (TRU) material back in the pit will be performed in a manner so as not to interfere with the retrieval process or the creation of prepared floors, and so as not to create a new source of contaminant spread within the retrieval area. This material will be packaged in containers (e.g., 5 x 5 x 6-ft boxes) in the facility to be designed for the treatment process for OU 7-10 Stage III Project. These containers will be carefully placed behind the excavation.

3 This packaged material (less than 100 nCi/g) will fit in the pit after packaging without further disturbance of soil. In addition, when backfilling this material, it is assumed that no dust will be generated that would cause resuspension of the plutonium fines. Backfill materials will consist of semiclean materials, second layer of overburden soils removed from pit, clean soils, top layer of overburden removed from the pit, and clean soils from the Site borrow areas.

ALTERNATIVE DESCRIPTIONS

See Table E-1.

DESIGN CONSIDERATIONS

Contamination Control

The contamination-control system-design features listed below are essential

1. The contamination-control system design can be based on one of the two following alternatives:

    a. Working "clean" by minimizing the spread of contaminants to retrieval equipment and the interior building surfaces with the goal of maintaining levels to allow bubble-suited entry. It is assumed that entry will be required only if emergency repairs are required. Spraying fixants (e.g., strippable paint) on surfaces and allowing the ventilation system to clear the air also is expected to be necessary.

    b. Working "dirty" and providing remotely controlled systems to perform maintenance. Providing for the disposal of retrieval equipment would be necessary, as decontamination will be impossible.

For the working-clean alternative, there are many dust-control measures that can be used including the following:

- Ultra-fine water misting systems, fixative sprays at the point of digging and dumping, and directed airflow and air curtains to contain movement of generated dusts
- Prepared floors that can be easily sprayed with fixatives
- Partitioning with electrostatic curtains to minimize the spread of dust and contaminants to smaller areas in a larger retrieval area
- Overhead cranes and gantry cranes to mobilize retrieval equipment and eliminate vehicle traffic over contaminated surfaces areas
- Pretreatment of the waste with a material (e.g., paraffin) that agglomerates small fines into larger nonaerosolizable particulate
- Fixing contaminants and clearing the air at the end of operations and for maintenance. Although contamination spread will be kept to a minimum, decontamination efforts will still be significant enough to require personal protective equipment for manned entry into the facility.

For the working-dirty option, completely robotic or remote control technology used in an operation similar to hot cell operation must be employed. Two important factors in this type of operation are the need to perform remote maintenance of equipment and the difficulty of disposing of equipment at the end of the campaign. Retrieving buried TRU heterogeneous waste will involve a variety of large tools and robotic equipment that most likely will not be decontaminable. Therefore, the facility will have to be modified to become a size reduction facility at the end of its life to size reduce, package, and transport the packages of size-reduced retrieval equipment out of the retrieval area for disposal. Because of the excessive weight of retrieval equipment, it is unlikely that the material will be considered TRU waste; however, in some cases, it might be contaminated to levels that disallow shallow land burial in sites such as the Idaho National Engineering and Environmental Laboratory (INEEL) Comprehensive Environmental Response, Compensation, and Liability Act Disposal Facility.

2. The design should include state-of-the art on-site analysis techniques to evaluate smear samples and air samples in a timely manner such that the contamination levels can be compared to set operating and safety limits.

3. The contamination control approach should allow retrieval of the pit at the appropriate throughput rate.

4. The contamination control approach should be extended into the processing and treatment facility because facility processes such as shredding present unique contamination control issues.

5. The attributes of the contamination-control system at the retrieval area should not hinder or adversely affect processes in the processing and treatment area.

6. The attributes of the contamination-control system at the retrieval area should not hinder or adversely affect the capability to characterize the retrieved waste.

Table E-1. Description of contamination-control systems for the Operable Unit 7-10 Stage III Project retrieval process.

Alternative	Contamination Control Equipment and Methods	Comments	Rating[a]
1	Rapid TRU monitoring laboratory or equivalent, remote retrieval of grab samples and smears.	A system providing this capability designed, tested, and documented, but not available from a vendor. Also, no personnel are trained to operate this system.	3
2	In situ grouting application of paraffin to waste to eliminate dust spread (pretreatment of waste)	Grouting of paraffin-based material in buried waste has been demonstrated. The grout-delivery system is currently at the conceptual design stage for the OU 7-13/14 application for grout in the SDA. The suspension of Boron-10 is claimed by the grout vendor as being possible, but must be verified. The paraffin fills all voids in the waste and allows a dust-free retrieval. The paraffin does not interfere with the retrieval process. Paraffin would have a significant impact on the treatment of organics.	2
3	Standard misting and fixative application, use of prepared floors, use of partition curtains, use of directed air-flow	All standard equipment would require modification for hose reel management and delivery involving bridge cranes or gantry cranes. Testing shows potential for at least 70% control of dust spread, which is an indicator of plutonium spread during digging, dumping, and vehicle traffic operations.	3

Table E-1. (continued).

Alternative	Contamination Control Equipment and Methods	Comments	Rating[a]
4	Size reduction equipment for the working-dirty concept	Special design required. Size reduction and packaging have been done at Rocky Flats Plant, but remote operations will present special design problems and significant costs.	1
5	General facility ventilation	Well documented and many examples from past retrieval projects for high-efficiency particulate air filtration and carbon filtration requirements already exist. The design of this system will lead design of the retrieval equipment.	3
6	Apply ISV as a pretreatment	ISV is currently an option for the buried TRU waste for OU 7-13/14. Following the ISV process, retrieval could be accomplished by a single individual in a sealed cab with no potential for fire and explosion. In addition, retrieval could be accomplished with only a weather shield to allow all-season operation. The spread of plutonium fines during retrieval is expected to be almost nonexistent because the fines are chemically locked-up in the glass phase. In addition, this process allows a fast, accurate assay of the retrieved vitrified waste. Also reduces processing and treatment needs. The densification process associated with ISV most likely will result in a much higher fraction of material being shipped out of the State of Idaho to the Waste Isolation Pilot Plant. Technology does not meet current OU 7-10 Record of Decision (DOE-ID 1993) or scope of work for the OU 7-10 Stage III Project	1
7	Introduce liquid nitrogen in a series of wells to freeze the waste to -100°F.	Process has been demonstrated in the laboratory and in the field with simulated waste. Achieved 90% dust control. Added benefit is that there is zero potential for migration of contaminants in the frozen state prior to the retrieval process. Also there is zero potential for fire, explosion, and criticality. Once the initial temperature is achieved, maintenance costs are low to keep the field frozen. Retrieving the frozen material is very difficult because it is extremely hard.	2
8	Use precise overburden removal techniques to reduce the amount of overburden that can slough off onto the retrieval area.	Process demonstrated to be effective without dust and contamination spread. However, there was an exposed subsidence hole in the INEEL cold test pit when applying this technology. Past retrieval studies show the importance of overburden removal before retrieval to avoid sloughing and aerosolization of plutonium.	3

Table E-1. (continued).

Alternative	Contamination Control Equipment and Methods	Comments	Rating[a]
9	Electrostatic curtains to attract aerosolized plutonium	Demonstrated technology at INEEL. Plutonium can attach to both negatively and positively charged surfaces. May have to use a partition between areas to separate a relatively clean packaging area from the relatively dirty retrieval area.	

a Rating

3 = High probability of applicability
2 = Possible applicability
1 = Low probability of applicability to Stage III Project
0 = Not practical for Stage III Project

INEEL = Idaho National Engineermg and Environmental Laboratory
ISV = in situ vitrification
OU = operable unıt
SDA = Subsurface Disposal Area
TRU = transuranic

NOTES

Retrieval of debris and process waste from the former Rocky Flats Plant[b] that are presently buried in shallow-land burial sites at the SDA is a challenging procedure because of the nature of the contaminants. The ease with which plutonium/americium oxides within the waste attach to dust particles that mobilize with air movement is well documented. Also well documented is the extremely small amount of allowable uptake to the lungs of the TRU materials. Compounding the problem is the relatively high percentage of fines in the INEEL soil (i.e., Spreading Area B) used as backfill during the landfill operations in the pits.

When this soil dries, it is easily aerosolized by digging, dumping, and vehicle traffic, which are the main components of most retrieval processes. The high rate of contamination-spread possible during OU 7-10 retrieval activities and the biological risk from this spread make contamination control a major priority of the retrieval design.

b. The Rocky Flats Plant is located 26 km (16 mi) northwest of Denver. In the mid-1990s, it was renamed the Rocky Flats Environmental Technology Site. In the late 1990s, it was again renamed, to its present name, the Rocky Flats Plant Closure Project.

REFERENCE

DOE-ID, 1993, *Record of Decision: Declaration of Pit 9 at the RWMC Subsurface Disposal Area at the Idaho National Engineering Laboratory*, Administrative Record No. 5569, U.S. Department of Energy Idaho Operations Office; U.S. Environmental Protection Agency, Region 10; and Idaho Department of Health and Welfare.